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A NEW XYSTODESMID MILLIPED GENUS AND THREE NEW SPECIES FROM PIEDMONT SOUTH CAROLINA (POLYDESMIDA: XYSTODESMIDAE)

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Abstract.—The new xystodesmid milliped genus *Furcillaria* is proposed for three new species in Piedmont South Carolina—*aequalis, convoluta,* and *laminata.* The acropodites of the gonopods of these species display proximal torsion and distal division into tibial, and variously modified solenomerite, branches. The former results in a crossing of the prostatic groove from medial to lateral sides as it runs along the stem of the acropodite; the latter imparts a forked appearance to the structure. Specific differences obtain in the relative lengths of the two branches; the degree of modification of the solenomerite branch; the presence, absence, and configuration of a medial flange at midlength of the acropodite; and the presence, absence, and configuration of a prefemoral process. The species are widely allopatric and occupy limited ranges; that of *aequalis* is nearly linear in shape. *Furcillaria* is closely related to *Dynoria,* the acropodites of which lack torsion, and the prostatic groove is therefore visible in medial view for its entire length along the stem of the structure. Of the species, *aequalis* and *convoluta* are closely related and appear to have a common ancestor, but *laminata,* which is quite different anatomically, represents a different phylogenetic line from another source.

The environments of piedmont South Carolina are an unlikely place to find xystodesmid millipeds. Much of the area is covered with dense stands of loblolly pine, *Pinus taeda,* and tracts of hardwoods large enough to provide sufficient leaf litter are mostly restricted to narrow bands along water courses. Cool, moist sites are rare in this part of the state, and droughts and diurnal temperatures around 100°F are common in summer. Despite these seemingly unfavorable conditions, however, the region harbors a diverse xystodesmid fauna. *Pachydesmus crassicutis incursus* Chamberlin, of the tribe Pachydesmini, occurs throughout the area (Shelley and Filka, 1979), and the tribe Rhysodesmini is represented by *Boraria stricta* (Brolemann) in the north and *Pleuroloma plana* Shelley in the south (Filka and Shelley, 1980; Shelley, 1980a). The known fauna of the tribe Apheloriini includes around a dozen species, some undescribed, in the genera *Brevigonus, Cleptoria, Croatania,* and *Sigmoria* (Hoffman, 1967; Shelley, 1976, 1977, 1980b).

The purpose of this contribution is to diagnose a fifth apheloriine taxon, *Furcillaria,* named for the forked condition of the male gonopods, which is comprised of three species.

Furcillaria is the third new apheloriine genus I have proposed for piedmont South Carolina xystodesmids, the others being *Croatania* and *Brevigonus* (Shelley, 1977, 1980b). The new genus was discovered in 1976 when I visited the area to ascertain the range and species composition of *Croatania. Furcillaria* is not as abundant as *Croatania,* however, and several return trips were required to obtain more material. Its species are widely allopatric, and meticulous sampling in intervening areas was necessary to determine whether additional forms existed. Thus, proposal of *Furcillaria* has been delayed pending these investigations, but current knowledge seems to be complete, and further fieldwork would probably yield only inconsequential information. Only 58 specimens were available for this study due to the rarity and restricted distributions of the three species; except for one male in the private collection of Richard L. Hoffman (RLH), all were collected by the author or an assistant and are deposited in the invertebrate research collection of the North Carolina State Museum (NCSM). Thus, in the locality sections of the ensuing species accounts, the collector's name is omitted for samples taken by the author alone, and the invertebrate catalog number is cited in parentheses for samples housed at the NCSM.

Furcillaria is closely related to *Dynoria* and therefore compels attention to this unrevised genus and the problems of its identity and characteristics. Ideally, they should be considered together in a single paper, but a revision of the latter is still several years away and more fieldwork is necessary in parts of its range. Thus, since the taxonomy of *Furcillaria* has been worked out, it seems desirable to establish the genus now rather than delay publication indefinitely for a related study. However, it is necessary to comment briefly on *Dynoria* at this time, so that *Furcillaria* will be adequately proposed and can be distinguished from the former if questions arise before the latter can be revised.

The original proposal of *Dynoria* by Chamberlin (1939) did not mention any discriminating features. *Dynoria icana* can be recognized from the sketchy drawing, however, thus enabling one to identify the genus although no diagnostic characters have ever been verbalized. Chamberlin's only comment about the gonopods of *Dynoria,* "... the blade of the telopodite ... bears a smaller branch from its anterior surface or outer edge, this arising from about the middle of the length," is also applicable to *Furcillaria.* In both taxa the acropodites are divided distally into two branches, a solenomerite branch which carries the prostatic groove and may be further divided or modified, and an unmodified branch which is here labelled the tibial process to maintain consistency with previous designations for the rhysodesmine genera *Erdelyia* and *Pleuroloma* (Hoffman, 1962; Shelley,

1980a). Thus, this character is not diagnostic for *Dynoria,* but there is one feature about the genus which is unique and distinguishes it from all others in the Apheloriini. In *Furcillaria* and all other genera of the tribe the acropodites are twisted approximately 90° anteriomesiad at ¼ to ⅓ length, thus resulting in a crossing of the prostatic groove from medial to lateral sides as it runs along the stem of the acropodite. Consequently, one must view the gonopods medially and then laterally to follow the course of the channel. In *Dynoria,* however, the acropodite is not twisted, and consequently the prostatic groove is visible in medial view for its entire length along the stem of the acropodite, until it passes behind the solenomerite branch. Hence, the groove is completely masked in lateral view except for the distal portion on the solenomerite. Another way of describing this would be to say that the acropodites of *Dynoria* have been untwisted. Since this feature is unique to the two species currently in *Dynoria,* it seems appropriate to regard it as a generic-level character and to propose a new genus for forms with forked acropodites which display torsion. *Furcillaria* may therefore be defined as an apheloriine xystodesmid genus whose acropodites are distally divided into a tibial process and a variously modified solenomerite branch, and are also twisted some 90° anteriomesiad at ¼ to ⅓ length.

Taxonomic Characters

Color.—Although color and color pattern are generally poor taxonomic characters, the species of *Furcillaria* can be distinguished from sympatric apheloriine xystodesmids by the color of the paranota and metaterga. *Furcillaria aequalis* and *convoluta,* with solid black metaterga, have narrow red paranotal markings covering little more than the peritremata. Hence, they can be distinguished from sympatric species of *Cleptoria* and *Croatania,* which have much wider lateral spots extending mediad well beyond the peritremal thickenings onto the level surface of the paranota. North of the Enoree River in Union County, the only sympatric apheloriine species of comparable size to *convoluta* is *Croatania catawba* Shelley, which has yellow paranota. Hence, the two millipeds can be separated by color and size of paranotal spots. *Furcillaria laminata* is the only xystodesmid in its range displaying red metatergal stripes, enabling it to be identified in the field. *Sigmoria latior* (Brolemann), which also is striped in South Carolina, has not been encountered within the range of *laminata* but can be distinguished from it by smaller body size.

Gonopods.—The only anatomical structure of *Furcillaria* with taxonomic utility is the gonopod. The 4th and 5th sterna possess small to moderate, ventrally directed processes, but in contrast with *Croatania* (Shelley, 1977) they are too indistinct to identify the genus.

The most important fact about the gonopods of *Furcillaria* is that the

acropodites display torsion. This, along with their forked condition, are the key diagnostic features of the genus.

Several features of the gonopods are useful at the specific level, and the first is the *in situ* configuration in the aperture. That of *laminata* is unique in that the acropodites lie over or under each other in the caudal half of the opening and project laterad only to the opposite side (Fig. 11). Thus, the structures are wholly encompassed by the aperture and do not overlap another segment. In contrast, the acropodites of *aequalis* and *convoluta* cross near midlength in the midline of the aperture and extend forward to varying lengths beyond the anterior margin, overlapping the 6th sternum (Figs. 1, 6).

Regarding gonopod structure, the prefemoral process is absent from *laminata,* thus distinguishing it from its congeners, and the process is equivalent in length in *aequalis* and *convoluta,* but rounded in the former and spiniform in the latter (Figs. 3–4, 8–9, 13–14). On the acropodite, *laminata* lacks the midlength flange on the medial surface, which is present in *aequalis* and *convoluta.* This lamina is more variable in *aequalis* than in *convoluta,* but is generally short and subtriangular in the former with from one to several teeth on the outer margin. In *convoluta,* the flange is broader and less clearly demarcated from the stem of the acropodite, and the margin is smooth though irregularly sculptured in some individuals. The flange terminates at the point (about ⅔ length) where the acropodite forks into the tibial and solenomerite branches. In *aequalis,* as the name implies, the two branches are subequal in length, whereas the tibial process is much shorter in the other two species. The solenomerite of *aequalis* is also a short, straight, simple blade, whereas it is highly modified in *convoluta* and *laminata.* In *convoluta* the solenomerite is thickened, twisted, and lined with ridges and grooves. It is also bent 90° submediad at midlength. In *laminata* the branch is further divided into three lamina, forming one of the most complex gonopod structures in the Apheloriini. The curvature of the acropodite is the final taxonomic character of the gonopods. It overhangs and extends well beyond the level of the prefemoral process (prefemur) in all three species. In *aequalis* and *laminata* the configuration is a smooth, continuous arch, but in *convoluta* the curve is bent sharply twice, at ⅓ length and about halfway on the solenomerite.

In summary, *aequalis* and *convoluta* possess a number of similarities and are most readily separated by the configuration of the solenomerite and its length relative to that of the tibial process. *Furcillaria laminata,* however, differs markedly from its congeners in several features and can be quickly identified by the striped color pattern, the *in situ* gonopodal configuration in which the acropodites lie wholly within the aperture, the complex, the subdivided solenomerite branch of the acropodite, and the absence of the prefemoral process and medial flange.

Furcillaria, new genus

Type-species.—Furcillaria aequalis, new species.

Description.—A genus of large, robust xystodesmids with the following characteristics:

Body composed of head and 20 segments in both sexes; size varying from 11–12.5 mm wide and 44–54 mm long; W/L ratio similarly varying from around 23.0–26.0%. Body essentially parallel-sided in midbody region, tapering at both ends.

Color in life variable; two species with solid black metaterga and narrow red paranotal spots covering little more than the peritremata; one species with brown base color, light red metatergal stripes, and wide, concolorous paranotal spots.

Head of normal appearance, smooth, polished. Epicranial suture distinct, terminating in interantennal region, not apically bifid; interantennal isthmus relatively wide; genae not margined laterally, with shallow central impressions, ends broadly rounded and projecting slightly beyond adjacent cranial margins. Antennae moderately slender, varying in length, becoming progressively more hirsute distally, with 4 conical sensory cones on ultimate article; no other sensory structures apparent. Facial setae reduced; epicranial and interantennal absent, clypeal and labral present, with or without frontal and genal setae.

Terga smooth, polished, becoming coriaceous in paranotal regions. Collum variably broad, ends subequal to or extending slightly beyond those of following tergite. Paranota moderately depressed, continuing slope of dorsum, caudolateral corners rounded on anteriormost segments, becoming blunt in midbody region and progressively more acute posteriorly. Peritremata distinct, strongly elevated above paranotal surface; ozopores located caudal to midlength, opening dorsad. Prozonites smaller than metazonites; strictures distinct, smooth.

Caudal segments normal for family.

Sides of metazonites irregular, with varying shallow, curved impressions. Strictures sharp, distinct. Pregonopodal sterna of males modified as follows: that of segment 4 with medial process of variable length but shorter than widths of adjacent coxae; sternum of segment 5 with two knoblike processes between 4th legs, distinct but varying in length, coalesced into single medial process in one species, with two slightly smaller and broader processes between 5th legs; sternum of segment 6 with or without shallow convex recession between 7th legs. Postgonopodal sterna generally flattened, with varying shallow grooves and depressions, strongly bilobed on segment 8 in some forms. Gonopores on 2nd leg pair of males moderately long, with round, apical knobs. Pregonopodal legs densely hirsute; postgonopodal legs becoming progressively less hirsute caudally. Coxae usually with blunt tu-

bercles in caudal half of body; prefemoral spines relatively long and sharply pointed; tarsal claws bisinuate. Hypoproct moderately acute medially; paraprocts with margins strongly thickened.

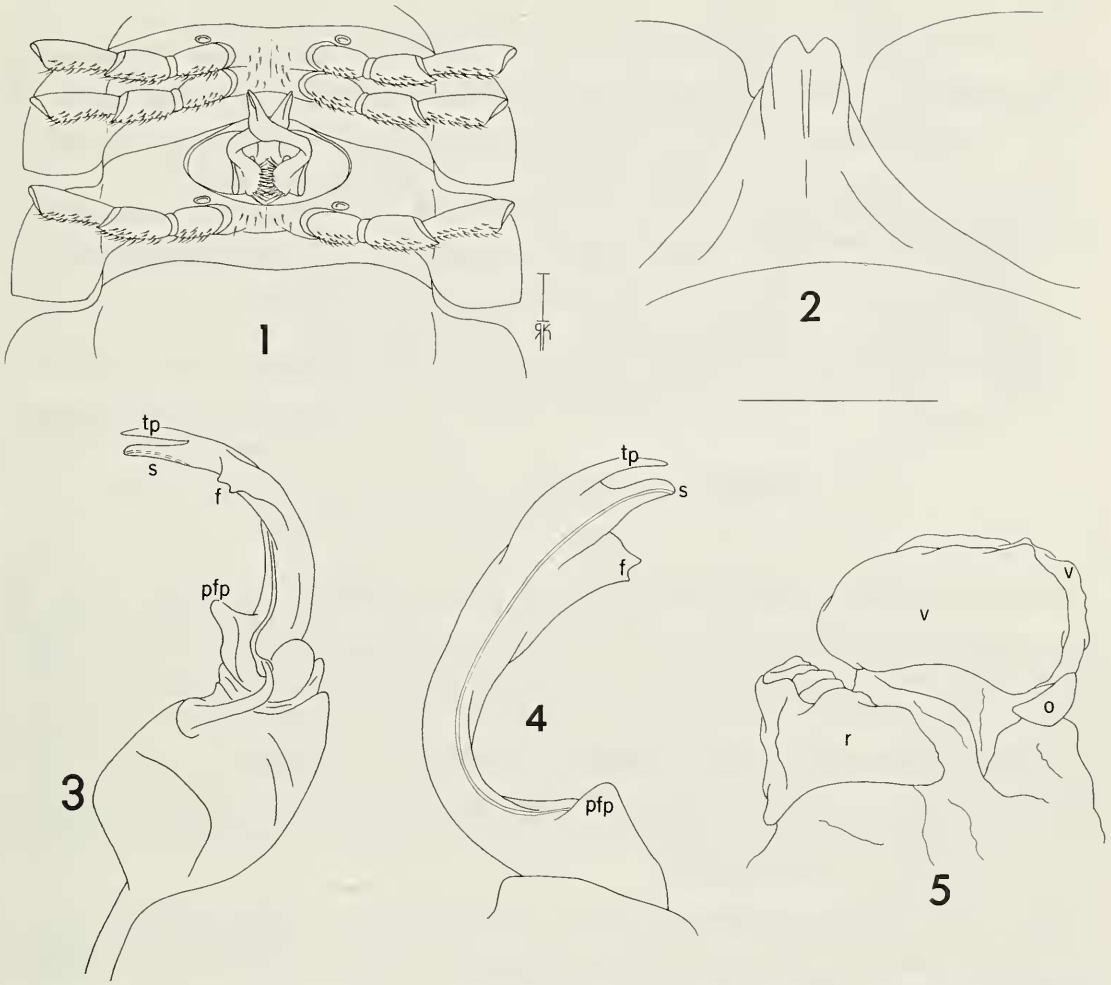
Gonopodal aperture ovoid to elliptical, with or without slight anteriolateral indentations, front flush with metazonal surface, sides elevated. Gonopods *in situ* with variable configurations, crossing at various points in midline of aperture. Coxae moderate in size, without apophyses, connected by membrane only, no sternal remnant. Prefemur small to moderate in size, with or without small to moderate prefemoral process on anteriomedial side; latter either blunt or narrow and spiniform in shape. Acropodite moderately thick and heavy, twisted about 90° anteriomesiad proximally, configuration either a smooth continuous arch or bent sharply at ⅓ length and apically, overhanging and extending well beyond level of prefemoral process (or prefemur), divided at ⅔ length into tibial process and another variously modified and subdivided branch carrying the prostatic groove; with or without broad or subtriangular flange on medial surface proximal to division. Tibial process short, straight, and sharply acute apically. Solenomerite varying from a simple, straight blade, to broad spatulate structure divided into three lamellae, to complex twisted projection with grooves and ridges; tip likewise varying from rounded, to uncate, to flattened with groove opening subterminally on inner surface of gonopod. Prostatic groove arising in pit on prefemur, proximal portion visible in medial view, crossing to lateral side on proximal third of acropodite and running along inner face, opening terminally or subterminally on solenomerite.

Cyphopodal aperture broad, encircling 2nd legs, sides flush with or slightly elevated above metazonal surface. Cyphopods *in situ* located lateral to 2nd legs, variously oriented in aperture, with valves or receptacle visible in openings. Receptacle small or large, located subdorsally to valves or cupped slightly around ventral side, surface roughened with folds and ridges. Valves moderate and subequal in size, surface finely granulate. Operculum usually relatively large, clearly visible under free end of valves.

Distribution.—Piedmont Plateau of South Carolina, ranging latitudinally from the Pacolet to the Savannah rivers, and longitudinally from the fall zone to nearly the base of the Blue Ridge escarpment. The encompassed area is roughly triangular in shape (Fig. 17), and each species occupies a narrow band in the generic range.

Species.—Three. Due to the intensity with which piedmont South Carolina has been investigated, it seems unlikely that additional species remain to be discovered.

Remarks.—*Furcillaria aequalis* and *laminata,* whose gonopods either do not (*laminata*) or barely (*aequalis*) extend beyond the anterior margin of the gonopodal aperture, both possess a recessed sternum between the posterior legs of segment 6. However, *convoluta,* whose gonopods extend well



Figs. 1–5. *Furcillaria aequalis:* 1, Gonopods *in situ,* ventral view of paratype. 2, Process of 4th sternum of holotype, caudal view. 3, Left gonopod of holotype, medial view (setation omitted from all dissected gonopod drawings). 4, The same, lateral view. 5, Left cyphopod of female paratype, caudal view. f, flange; o, operculum; pfp, prefemoral process; r, receptacle; s, solenomerite branch (=solenomerite); tp, tibial process; v, valves. Scale line for Fig. 1 = 1.0 mm; scale line for other figs. = 1.0 mm.

beyond the aperture and overlap the 6th sternum, lacks this cavity. This depression, common in apheloriine genera with curved or rounded acropodites, provides space for the apical curvatures when the body segments are compressed. Its presence in species of *Furcillaria* which do not seem to need it, and its absence from one which does, are curious features of their anatomies.

Key to Species of *Furcillaria* (Based Mainly on Adult Males)

1. Gonopod with prefemoral process and medial flange at midlength of acropodite; metaterga solid black in color, without stripes 2
– Without these gonopodal characters; metaterga brown with light red-

dish stripes along caudal margins; Pickens and Anderson counties ..... *laminata,* new species

2. Solenomerite a flat, simple blade, subequal in length to tibial process; flange relatively short, subtriangular, clearly demarcated from stem of acropodite, margin with one to several teeth; Saluda to McCormick counties ..... *aequalis,* new species

– Solenomerite twisted, with several ridges and shallow grooves, much longer than tibial process, bent 90° near midlength; flange relatively broad and long, poorly demarcated from stem of acropodite, margin variable but smooth, without teeth; Spartanburg to Newberry counties ..... *convoluta,* new species

Furcillaria aequalis, new species
Figs. 1–5

Type-specimens.—Male holotype (NCSM A1463) and one male and one female paratype collected by R. M. Shelley, 8 August 1976, from Edgefield Co., South Carolina, 11.3 mi. NW Edgefield, along SC highway 283 at Turkey Cr. (McCormick Co. line) in Sumter National Forest. Two male and two female paratypes, same collector, same date, Edgefield Co., 11.4 mi. NW Edgefield, along SC highway 68, 0.2 mi. N junction of SC highway 52, Sumter National Forest. Male and female paratypes deposited in Florida State Collection of Arthropods.

Diagnosis.—Solenomerite a simple, straight blade without lobes or projections, apically rounded, length subequal to that of tibial process; flange relatively short and subtriangular, clearly demarcated from stem of acropodite, margin with one to several sharply pointed teeth.

Holotype.—Length 50.6 mm, maximum width 11.9 mm, W/L ratio 23.5%, depth/width ratio 61.3%. Segmental widths as follows:

collum	8.5 mm	7th–11th	11.9
2nd	9.1	12th–14th	11.6
3rd	9.9	15th	11.0
4th	10.5	16th	10.4
5th	11.1	17th	9.0
6th	11.3	18th	7.0

Color in life: Peritremata bright red, smoothly grading into black base color on level surface of paranota; metaterga dark glossy black, without stripes; collum with suggestion of red stripe along anterior edge.

Head capsule smooth, polished, width across genal apices 5.4 mm; interantennal isthmus 1.9 mm, smooth; epicranial suture distinct and relatively deep, terminating in slight impression in interantennal region. Antennae reaching back to caudal edge of 3rd segment, becoming progressively more hirsute distally; first antennomere subglobose, 2–6 clavate, 7 short and trun-

cate; relative lengths of antennomeres 2 > 3 = 6 > 4 = 5 > 1 > 7. Genae not margined laterally, with slight central impressions, ends broadly rounded and projecting slightly beyond adjacent cranial margins. Facial setae as follows: epicranial and interantennal absent, frontal 1-1, genal 1-1, clypeal about 10-10, labral about 14-14.

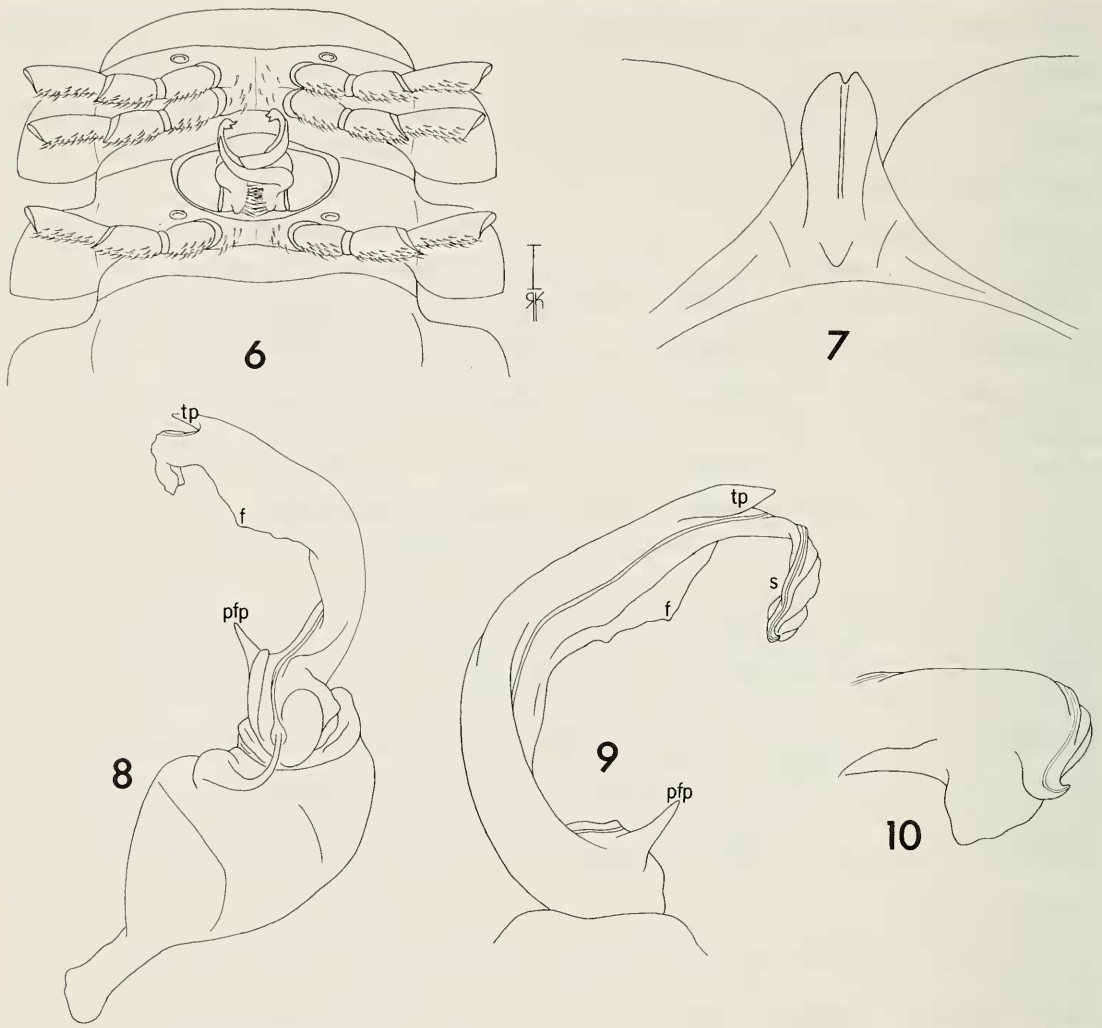
Terga smooth, polished, becoming moderately coriaceous on paranota. Collum broad, ends not extending beyond those of 2nd segment. Paranota moderately depressed, angled ventrad and continuing slope of dorsum, caudolateral corners rounded through segment 5, becoming progressively more pointed posteriorly. Peritremata thick and conspicuous, sharply set off from paranotal surface, produced slightly caudad beginning on segment 8. Ozopores located caudad to middle of peritremata, opening dorsad.

Sternum of segment 4 with small, apically divided process between 3rd legs (Fig. 2), shorter than width of adjacent coxae; of segment 5, produced into two conical paramedian knobs between 4th legs and two broader, smaller knobs between 5th legs; of segment 6, convexly recessed between 7th legs. Postgonopodal sterna generally glabrous, with varying shallow grooves and impressions, including transverse grooves originating between leg pairs and large, central depression. Minute coxal tubercles present on legs of segments 12–17; prefemoral spines beginning on segment 6, becoming progressively longer and more sharply pointed caudally; tarsal claws bisinuately curved. Hypoproct slightly pointed medially, paraprocts with margins strongly thickened.

Gonopodal aperture broadly ovoid, 4.0 mm wide and 2.3 mm long at midpoint, indented slightly on anteriolateral margin, front flush with metazonal surface, sides elevated and slightly thickened. Gonopods *in situ* (Fig. 1, of paratype) with acropodites crossing near midlengths in midline of aperture, extending slightly foward beyond anterior margin of aperture and just over 6th sternum. Gonopod structure as follows (Figs. 3–4): Prefemur small, with short, blunt prefemoral process directed toward tip of acropodite. Acropodite a smooth continuous arch overhanging and extending well beyond level of prefemoral process, with flange on medial surface proximal to division. Tibial process apically acute, length subequal to that of solenomerite. Latter a simple, flat, apically rounded blade. Flange relatively short and subtriangular, distinct and clearly demarcated from stem of acropodite, arising at about ⅓ length, terminating proximal to division of acropodite, with two sharply pointed teeth on outer margin. Prostatic groove crossing from medial to lateral sides, running along inner surface of acropodite to subterminal opening on inner surface of solenomerite.

Male paratypes.—The male paratypes agree closely with the holotype in all structural details.

Female paratype.—Length 49.1 mm, maximum width 11.7 mm, W/L ratio 23.8%, depth/width ratio 68.4%. Agreeing essentially with holotype in so-



Figs. 6–10. *Furcillaria convoluta:* 6, Gonopods *in situ,* ventral view of paratype. 7, Process of 4th sternum of holotype, caudal view. 8, Left gonopod of holotype, medial view. 9, The same, lateral view. 10, Apical portion of solenomerite of holotype, oblique medial view, showing uncate tip and subterminal, subtriangular lobe. Abbreviations as in Figs. 1–5. Scale line for Fig. 6 = 1.0 mm; line for other figs. = 1.0 mm.

matic features except paranota more strongly depressed, creating appearance of more highly arched body.

Cyphopodal aperture with edges flush with metazonal surface. Cyphopods *in situ* lying transversely in aperture, valves visible externally, receptacle on medial side adjacent to legs. Receptacle (Fig. 5) relatively small, located dorsally with respect to valves, not cupped around valves, surface with several low ridges and crests. Valves moderate, surface finely granulate. Operculum relatively large, located opposite receptacle or dorsolaterally in relation to valves.

Variation.—The gonopods of *aequalis* are quite uniform. In a few specimens the acropodite is more upright than in the holotype, forming less of

an arch and extending only slightly beyond the level of the prefemoral process. The configuration of the prefemoral process varies slightly from the condition in the holotype, being more apically acute and wedge-shaped in some individuals, and shorter and blunter in others. The most conspicuous variation involves the shape of the flange, which may be acutely triangular with a single sharp point on the outer edge, or irregularly notched with several unequal teeth.

Etymology.—The specific name refers to the equivalent lengths of the solenomerite and tibial process.

Distribution.—Eastern Piedmont Plateau of southern South Carolina. The Savannah River appears to form the southern boundary, as *aequalis* occurs up to the river along SC highway 28 in McCormick County, but concerted efforts to find it across the river in Columbia and Richmond counties, Georgia, have been unproductive. There is no clear boundary on the northern side, but the species has not been collected outside of the Sumter National Forest. The range is narrow and linear, and extends from Saluda to McCormick counties (Fig. 17). Specimens were examined as follows:

SOUTH CAROLINA: *Saluda Co.,* 10.7 mi. W Saluda, at first creek off SC hwy. 38 in Sumter National Forest, F, 4 May 1977 (A1530). *Edgefield Co.,* 12 mi. NE Edgefield, along US hwy. 378 at Rocky Cr., 1.6 mi. W jct. US hwy. 25, M, F, 15 July 1979, R. M. Shelley and R. K. Tardell (A2820); 11.4 mi. NW Edgefield, along SC hwy. 68, 0.2 mi. N jct. SC hwy. 52, 2M, 2F, 8 August 1976 (A1464); 11.3 mi. NW Edgefield, along SC hwy. 283 at Turkey Cr. (McCormick Co. line), 2M, F, 8 August 1976 (A1463) TYPE LOCALITY; and 9.6 mi. NW Edgefield, along SC hwy. 35 at Turkey Cr., M, 5 May 1977 (A1532). *McCormick Co.,* 3.8 mi. S Modoc, M, 30 April 1960, L. Hubricht (RLH); 4.3 mi. SE Modoc, along SC hwy. 88 at Stevens Cr., F, 5 May 1977 (A1534); and 7.4 mi. SE Modoc, along SC hwy. 28, 1.0 mi. S jct. SC hwy. 200, 3M, 8 August 1976 (A1462).

Furcillaria convoluta, new species
Figs. 6–10

Type-specimens.—Male holotype (NCSM A1461) and two male and four female paratypes collected by R. M. Shelley, 5 August 1976, from Newberry Co., South Carolina, 9.4 mi. NW Newberry, along SC highway 32 at Indian Cr., Sumter National Forest. One male and two female paratypes, same collector, same location, 3 May 1977. Male and female paratypes deposited in Florida State Collection of Arthropods.

Diagnosis.—Solenomerite a complex, twisted structure, much longer than tibial process, bent 90° at midlength, with several narrow grooves and ridges, and subtriangular lobe shielding uncate tip; flange relatively long and broad, widest at midlength, poorly demarcated from stem of acropodite, margin smoothly irregular.

Holotype.—Length 53.4 mm, maximum width 12.3 mm, W/L ratio 23.0%, depth/width ratio 60.2%. Segmental widths as follows:

collum	8.2 mm	8th–13th	12.3
2nd	9.8	14th–15th	12.0
3rd	10.5	16th	11.0
4th	11.2	17th	9.6
5th	11.8	18th	7.6
6th–7th	12.1		

Color in life as described for *aequalis*.

Somatic features similar to those of *aequalis* with following exceptions:

Width across genal apices 5.5 mm, interantennal isthmus 2.4 mm. Antennae extending back to middle of 3rd segment, relative lengths of antennomeres $2 > 3 > 4 = 5 = 6 > 1 > 7$. Facial setae as follows: epicranial, interantennal, and frontal absent, genal 1-1, clypeal about 10-10, labral about 16-16.

Collum very broad, extending slightly beyond ends of following tergite.

Process of 4th sternum moderately large, length nearly equal to width of adjacent coxae (Fig. 7); knobs of segment 5 also much larger than in *aequalis,* anterior pair coalesced medially into single process in midline; 6th sternum not noticeably recessed between 7th legs, with slight groove in midline. Postgonopodal sterna strongly bilobed on segment 8, less so on segment 9, becoming flattened on 10 with wide, shallow, central impression and narrow transverse groove between leg pairs.

Gonopodal aperture subelliptical, 3.9 mm wide and 2.2 mm long at midpoint, indented along anteriolateral edge, front and sides elevated above metazonal surface, not thickened. Gonopods *in situ* (Fig. 6, of paratype) overlapping near midlength in region of flange, curving broadly over opposite side of aperture and extending forward over 6th sternum. Gonopod structure as follows (Figs. 8–10): Prefemur moderate, with moderately long, spiniform prefemoral process directed toward tip of acropodite. Acropodite forming arch with bend at ⅓ length and sharper distal bend on solenomerite, with flange on medial surface proximal to division. Tibial process apically acute, about half as long as solenomerite. Latter a complex twisted structure with several narrow grooves and low ridges, bent sharply (90°) at midlength, with distal, subtriangular, subterminal lobe shielding uncate tip. Flange relatively long and broad, poorly demarcated from stem of acropodite, arising at proximal bend, terminating at level of acropodal division, tapering smoothly to widest point at midlength; margin smooth but slightly irregular. Prostatic groove crossing from medial to lateral sides, running along inner surface of acropodite and a groove of solenomerite, opening apically on uncate tip.

Male paratypes.—The male paratypes agree closely with the holotype in all structural details.

Female paratype.—Length 50.8 mm, maximum width 11.7 mm, W/L ratio 23.0%, depth/width ratio 71.2%. Agreeing essentially with holotype in somatic features except paranota more strongly depressed, creating appearance of more highly arched body.

Cyphopodal aperture with sides flush with metazonal surface. Cyphopods *in situ* with valves oriented anterior-posterior in aperture, receptacle on anterior side of valves. Cyphopod structure as described for *aequalis*.

Variation.—There is less variation in the gonopods of *convoluta* than in those of *aequalis*. The only noticeable differences concern the shape of the prefemoral process and flange. The former is more acicular on some males, and the irregularities in the margin of the flange vary, although the general configuration of the structure is consistent in all specimens.

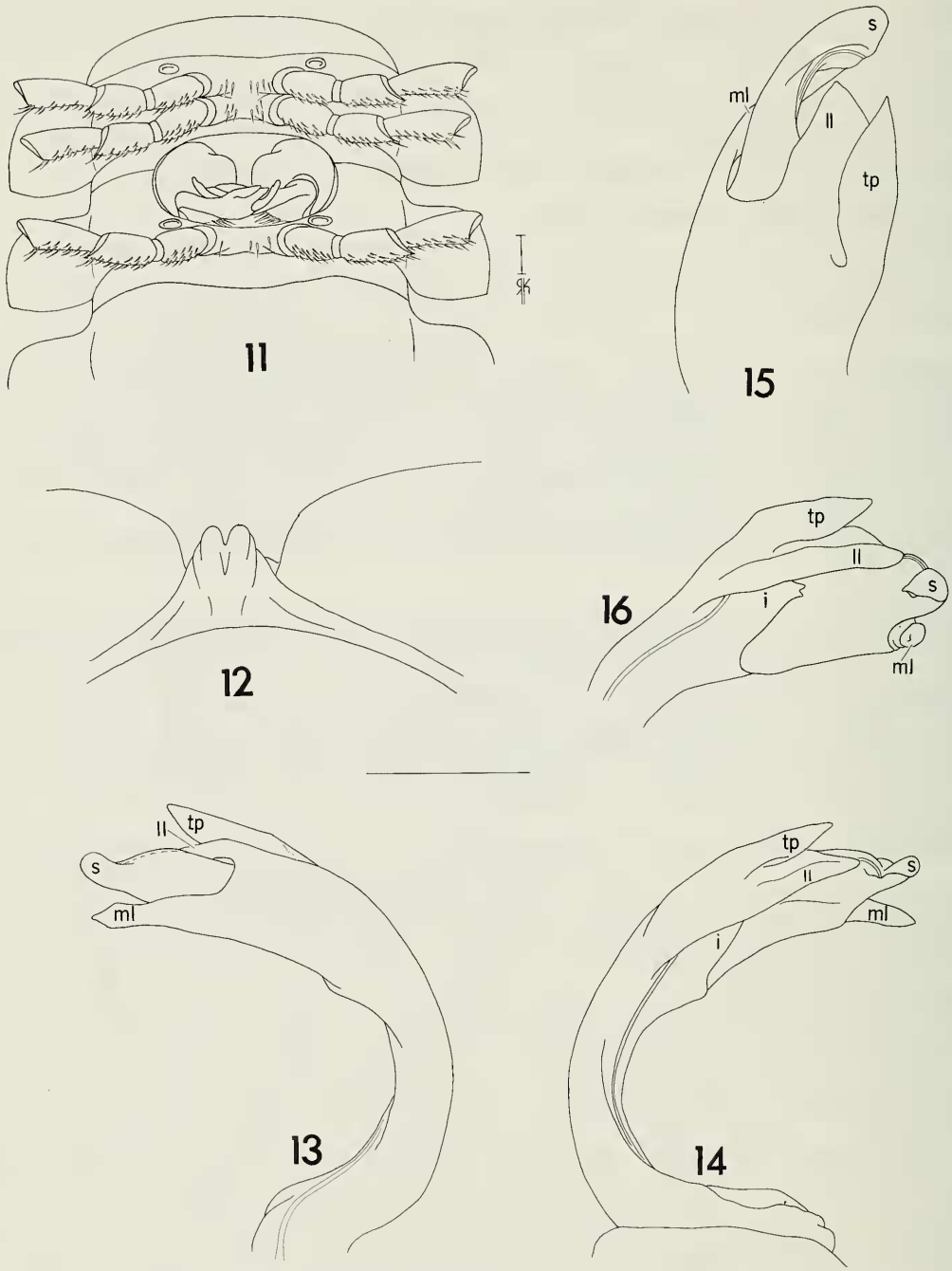
Etymology.—The specific name refers to the twisted condition of the solenomerite.

Distribution.—Central Piedmont Plateau of South Carolina from Spartanburg to Newberry counties. The area lies west of the Broad and south of the Pacolet rivers, and most of it is encompassed within the Enoree Division of the Sumter National Forest. The western and southern limits do not correspond to any known physiographic feature. Specimens were examined as follows:

SOUTH CAROLINA: *Spartanburg Co.,* 2.8 mi. S. Pacolet, along SC hwy. 150 at Isons Cr., M, 2F, 13 June 1978, R. M. Shelley and W. B. Jones (A2076); and 8 mi. E Woodruff, along SC hwy. 113 at Tyger R., M, 13 June 1978, R. M. Shelley and W. B. Jones (A1078). *Union Co.,* 6.4 mi. NW Union, along SC hwy. 279 at Fair Forest Cr., M, F, 2 May 1977 (A1511); 13 mi. SW Union, along SC hwy. 22 at Enoree R., Sumter National Forest, 3F, 2 May 1977 (A1512); and 7.3 mi. S Union, along SC hwy. 16 at Tyger R., Sumter National Forest, 3M, 5 August 1976 (A1460). *Laurens Co.,* 11.2 mi. NE Clinton, along SC hwy. 72 at Duncan Cr., Sumter National Forest, M, 9 May 1977 (A1563); and 6.4 mi. NE Clinton, along SC hwy. 26 at Duncan Cr., Sumter National Forest, 3M, 4F, 9 May 1977 (A1562). *Newberry Co.,* 9.4 mi. NW Newberry, along SC hwy. 32 at Indian Cr., Sumter National Forest, 3M, 4F, 5 August 1976 (A1461) and M, 2F, 3 May 1977 (A1519) TYPE LOCALITY.

Furcillaria laminata, new species
Figs. 11–16

Type-specimens.—Male holotype (NCSM A1616) and one female paratype collected by R. M. Shelley, 2 August 1977, from Pickens Co., South



Figs. 11–16. *Furcillaria laminata:* 11, Gonopods *in situ,* ventral view of paratype. 12, Process of 4th sternum of paratype, caudal view. 13, Left gonopod of holotype, medial view. 14, The same, lateral view. 15, Apical portion of telopodite of left gonopod, ventral view. 16, The same, subdorsal view. i, inner lamella; ll, lateral lobe of parasolenomerite; ml, medial lobe of parasolenomerite; s, solenomerite (≠ solenomerite branch); tp, tibial process. Scale line for Fig. 11 = 1.0 mm; line for other figs. = 1.0 mm.

Carolina, 8.5 mi. E Pickens (3.3 mi. NE Easley), along SC highway 192 at George's Creek. Two female paratypes, and two male and one female paratypes, same collector, same location, 8 May 1977 and 12 June 1978, respectively. Male and female paratypes deposited in Florida State Collection of Arthropods.

Diagnosis.—Distinguished by striped color pattern, *in situ* enclosure of acropodites wholly within gonopodal aperture, absence of prefemoral process and medial flange on telopodite, and division of solenomerite branch into three lamellae.

Holotype.—Length 44.2 mm, maximum width 11.3 mm, W/L ratio 25.6%, depth/width ratio 61.1%. Segmental widths as follows:

collum	7.8 mm	12th–14th	11.0
2nd	8.9	15th	10.5
3rd	10.0	16th	10.0
4th	10.7	17th	8.5
5th–11th	11.3	18th	6.0

Color in life: Paranota light red; metaterga brown with light red stripes along caudal edges connecting paranotal spots; collum with light red stripes along both anterior and caudal edges.

Somatic features similar to those of *aequalis* with following exceptions:

Width across genal apices 4.6 mm, interantennal isthmus 1.6 mm. Antennae extending back to middle of 3rd segment, relative lengths of antennomeres $2 > 3 > 6 > 4 = 5 > 1 > 7$. Facial setae as follows: epicranial, interantennal, frontal, and genal absent, clypeal about 10-10, labral about 16-16.

Collum broad, extending slightly beyond ends of following tergite.

Process of 4th sternum small, length much shorter than width of adjacent coxae (Fig. 12, of paratype); knobs of segment 5 small, subsimilar to condition in *aequalis*; segment 6 with shallow, convex recession between 7th legs. Postgonopodal sterna strongly bilobed on segment 8, less so on segment 9, becoming flattened and plate-like on 10 and continuing posteriorly.

Gonopodal aperture ovoid, 4.2 mm wide and 2.8 mm long at midpoint, without anteriolateral indentations, front flush with metazonal surface, sides slightly elevated. Gonopods *in situ* (Fig. 11, of paratype) with acropodites lying nearly directly over one another in posterior half of aperture, crossing midline and extending to opposite side of aperture, not projecting beyond margin. Gonopod structure as follows (Figs. 13–16): Prefemur small, without prefemoral process. Acropodite a smooth continuous arch overhanging and extending well beyond prefemur, without flange on medial surface. Tibial process apically acute, about ⅔ as long as solenomerite branch. Latter further divided into three lamellae as follows: the solenomerite proper; a parasolenomerite shielding proximal portion of solenomerite on ventral side

and extending forward as two lobes on either side of solenomerite; and a short, subtriangular lamella with two minute apical teeth on inner face of acropodite beneath proximal portion of solenomerite branch. Solenomerite curved slightly anteriodorsad, tapering gradually to rounded apex, with straight ridge on inner surface apically, extending proximad about ⅓ length of solenomerite. Lobes of parasolenomerite shorter than solenomerite but unequal; medial lobe longer than lateral, tapering to subacuminate tip; lateral lobe shorter, apically blunt and rounded. Prostatic groove crossing from medial to lateral sides, running along inner surface of acropodite, behind lateral lobe of parasolenomerite, and along lateral edge of solenomerite to subterminal opening on ridge on inner surface.

Male paratypes.—The male paratypes agree closely with the holotype in all structural details.

Female paratype.—Length 46.0 mm, maximum width 11.4 mm, W/L ratio 24.8%, depth/width ratio 68.4%. Agreeing essentially with holotype in somatic features except paranota more strongly depressed, creating appearance of more highly arched body.

Cyphopodal aperture with sides elevated above metazonal surface. Cyphopods *in situ* with side of receptacle visible in aperture, valves directed dorsolaterad. Receptacle large, cupped around medial side of valves, with lobe protruding through aperture, surface convoluted with deep folds and ridges. Valves moderate and equal in size, surface finely granulate. Operculum minute, hidden under free end of valves.

Variation.—The inner lamella on the gonopods of the male from Anderson County is slightly larger and more pronounced than on the type males, but otherwise the gonopods of males from both localities agree closely.

Etymology.—The specific name refers to the laminate condition of the gonopodal acropodite.

Distribution.—Central western Piedmont Plateau of South Carolina. With only two known localities, a full range description of *laminata* is impossible. However, both sites are between the Saluda and Toxaway-Savannah rivers, and the Pickens County site is only about 15 miles from the Blue Ridge Front. Thus, these physiographic features seem plausible range boundaries for *laminata*. The species is certainly rare, as in four years of fieldwork in piedmont South Carolina I have only encountered it five times, and only at these two sites. Consequently, it seems to warrant consideration for the "rare, exploitable, and vulnerable" category for arthropods other than Crustacea in the South Carolina endangered species list (Morse *et al.*, 1979). Specimens were examined as follows:

SOUTH CAROLINA: *Pickens Co.*, 8.5 mi. E Pickens (3.3 mi. NE Easley), along SC hwy. 192 at George's Cr., 2F, 8 May 1977 (A1558); M, F, 3 August 1977 (A1616); and 2M, F, 12 June 1978, R. M. Shelley and W. B. Jones (A2074) TYPE LOCALITY. *Anderson Co.*, 7.9 mi. SSE Anderson,

Fig. 17. Distribution of *Furcillaria* in South Carolina. Stars, *laminata*; squares, *convoluta*; dots, *aequalis*.

along SC hwy. 1459 at Rocky R., 3F, 7 May 1977 (A1551); and M, 2F, 2 August 1977 (A1615).

Ecology

The ecological requirements of *Furcillaria* are similar to those reported by Shelley (1977) for *Croatania*. Its species are not as plentiful as those of the latter genus, but *Furcillaria* is also available in the hottest, driest summer months, when few other diplopods are evident. *Furcillaria* also seems to have more specific habitat requirements, as I never found it in the purely or predominantly pine localities which *Croatania* occupies. Most of piedmont South Carolina is dominated by pine, but *Furcillaria* was always taken in environments with a large percentage of hardwoods, although beech woods and beech litter are avoided. The millipeds are typically found under thin layers of leaves close to water courses, most often along banks of small streams. The type locality of *laminata* consists of a large, subclimax, deciduous forest in a hilly region along an upper Piedmont stream. Several

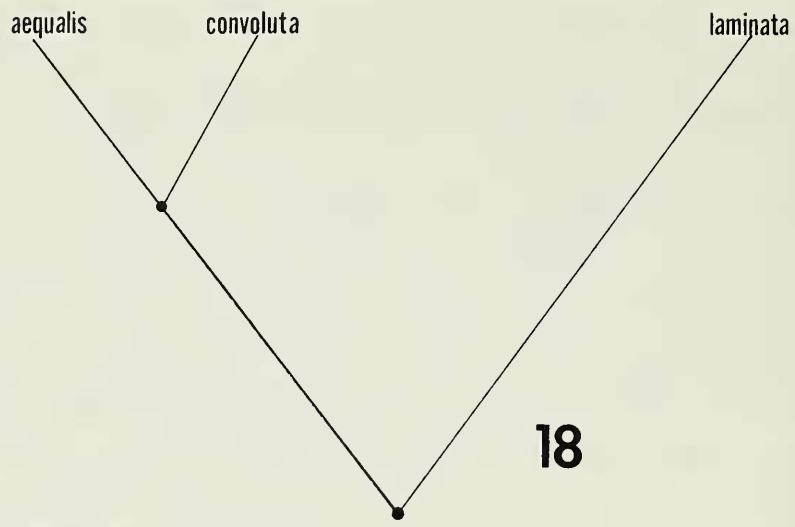


Fig. 18. Relationships in *Furcillaria*.

xystodesmids in addition to *laminata* were discovered in shallow, moist depressions on hillsides well above the water.

Distribution

Furcillaria occupies a roughly triangular area in piedmont South Carolina as shown in Fig. 17. The three species occupy limited, allopatric ranges, separated from each other by at least 30 miles. All are longer in the north–south direction than in the east–west; the range of *aequalis* is extremely narrow and nearly linear. The distributions also traverse moderate-size Piedmont rivers (such as the Enoree River by *convoluta*) rather than occurring along one side as does *Brevigonus shelfordi* (Loomis) (Shelley 1980b).

Relationships

Generic.—*Furcillaria* is most closely related to *Dynoria,* as explained in the introduction. Their ranges are mostly separated by the Savannah River, with *Furcillaria* occurring north-east in South Carolina, and *Dynoria* occurring south-west in Georgia and North Carolina. However, *Dynoria* extends slightly around headwater streams and occurs in the western fringe of Oconee County, South Carolina.

Specific.—The common properties of a prefemoral process, a medial flange, and a solenomerite lacking accessory lamellae point to a close relationship between *aequalis* and *convoluta.* The two appear to be sister species only one step removed from a common ancestor (Fig. 18); however, their significantly different gonopods suggest a lengthy period of isolation since dichotomy occurred. *Furcillaria laminata* is so entirely different that it can only represent a second phylogenetic line, probably from an earlier

source. Their restricted and widely allopatric distributions, and reduced abundances, suggest that the species are much older inhabitants of South Carolina than such widespread newcomers as the species of *Cleptoria* and *Croatania*. *Furcillaria* appears to be a remnant of an early fauna that is now in natural decline. Thus, the extreme rarity of *laminata* indicates a need for species consideration of its conservation status.

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